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Two Insect Associates of the California Pitcher-plant, *Darlingtonia californica* (Dipt.)

By FRANK MORTON JONES, Wilmington, Delaware.

(Plates XX, XXI.)

Metriocnemus edwardsi nov. sp. (Diptera: Chironomidae.) (Plate XX.)

In September, 1875, Mr. Henry Edwards communicated to the California Academy of Sciences the results of his observations on the insect associates of the California Pitcher-plant, *Darlingtonia californica*. Following thus closely after Melli-champ's and Riley's papers on our eastern *Sarracenias* and their insect victims and guests, it is noteworthy that *Darlingtonia*, by its peculiar structure, its insect-catching activity, and the number and variety of its victims evidently closely com-

parable with the better known *Sarracenias*, yet seemed to be almost destitute of insect associates other than victims of its traps. For example, with our eastern *Sarracenia purpurea*, from Canada to the Gulf, are found *Eryra rolandiana*, *Wyeomyia smithii*, *Metriocnemus knabi*, *Sarcophaga sarraceniae* (or related species), *Papaipema appassioata*, *Olethreutes dacckeana*, and other less constant associates; in *Darlingtonia* Mr. Edwards found only numerous small spiders (these are also abundant in *Sarracenia*) and "invariably among the mass of decay some living larvae of a small dipterous insect, probably one of the *Tipulidac*."

By the examination of numerous freshly-gathered vigorous plants of *Darlingtonia* furnished me at intervals through the summer of 1915 by Mr. A. A. Heller and Mr. G. M. Pendleton, I secured many living examples of the small dipterous larva noticed by Mr. Edwards, and also of another and larger species, both of which I succeeded in rearing in some numbers. The former proves to be closely related to *Metriocnemus knabi* Coq., the almost invariable associate of *Sarracenia purpurea*, differing but little in the imago, but as might be anticipated presenting more evident structural divergence in the larva and pupa; for the water-filled leaf of *purpurea* offers to the early stages of *knabi* a habitat almost strictly aquatic, whereas the new species, which may be called *Metriocnemus edwardsi*, seems perfectly at home among the insect remains in *Darlingtonia* as long as they are even slightly moist, and its pupal stage is passed, not as by *knabi* enclosed in a watery welt-like gelatinous mass on the inner wall of the pitcher, but (in captivity) outside the leaf, naked and loosely adherent to the moist basal portion of the plant or in the adjacent moss, over which it wriggles actively when disturbed. A single egg-mass, probably unfertilized, was obtained by confining the flies with *Darlingtonia* leaves and moist moss, but as they were not detected until after the death of the female which was found clinging to the partially-dried egg-mass, it is possible that further observation may modify the following description of the eggs and their method of deposition.

Egg.—Approximately circular in cross section, elongated, slightly more pointed at one end, clear pale yellow in color, of smooth and somewhat polished texture; length .22 mm.; cross diameter .11 mm.; deposited in a strongly adherent irregular mass; examined and measured at 100 X.

Larva.—Slender, almost cylindrical; smooth, pale, but darker than *knabi* and of a decidedly brownish rather than yellow-white tone; head darker, tending toward pale ferruginous; eye-spots black, prominent, sub-oval, not so obviously formed by the fusion of two spots as in *knabi*; antennae inconspicuous, shorter than in *knabi*; mandibles and labium dark brown, the former with five teeth proportioned as in *knabi* (Knab's illustration), the latter with a single pair of small teeth medially (not two pairs as in *knabi*) followed by a series of larger ones; claws of anterior and posterior prolegs yellowish-brown, in form as in *knabi*; dorso-caudal papillae slightly darkened and much lower, smaller, and less conspicuous than in *knabi*, in height about once their diameter, and armed with fine black setae which are often appressed into apparently one; some of these setae are frequently broken at various lengths or entirely missing, and the normal full number is probably six; four retractile anal blood-gills on the twelfth segment; length before pupation about 7 mm.

Pupa.—At first pale, soon darkening to dull brown and then to almost black with the pigmentation of the enclosed imago; of the usual form, with enlarged thorax but without projecting respiratory tubes or filaments; caudal end broadened, paddle-like, partly cleft, the two flattened lobes held in the same plane and rounded, each with three fine black setae usually appressed and appearing as a single tapering bristle on its exterior edge; the abdominal segments near their dorsal posterior edge have a fringe of short stout downward-pointing spines, amber-colored tipped with brown. The pupa is naked and quite active, travelling over moist surfaces with considerable facility. The duration of this stage is very short.

♂. Smoky brown to black; antennae 14-jointed, strongly plumose with black hairs, the disc-like basal joint more densely colored than the remaining somewhat translucent joints; eyes black; palpi four-jointed, the first joint shortened and bulb-like, the remaining three of approximately equal length, the first three joints bearing long hairs, the last joint with a few very short fine ones.

Thorax dark, concolorous, and with three lines of hairs springing from minute polished black rounded granules, the median line posteriorly abbreviated at less than half the length of the mesonotum, the lateral lines broadening and terminating only slightly in advance of the scutellum; a minute double pit medially, in line with the termination of

the lateral stripes; post alar callus somewhat produced and flattened, strongly haired; prealar callus protuberant, roughened, and strongly haired; scutellum narrow, rounded, pale brownish-gray, with a transverse row of long fine hairs; post-scutellum deep dull black, faintly polished and obscurely pitted; halteres club-shaped, usually pale, but smoky in heavily-pigmented examples; legs smoky brown with dark vestiture, the femora hairy; vestiture of tibiae shorter, though successively longer and more hair-like on the second and third pairs; front metatarsi about half the length of their tibiae; all tibiae spurred. Wings not very densely clothed with fine short gray-brown hairs, stronger on the costal edge; the R-M cross-vein either barely in contact with the radius without fusion, or in some examples failing to reach the radius by its own width; fork of cubitus slightly distad of origin of cross-vein.

Abdomen unmarked, smoky brown to dull black; clothed dorsally and ventrally with long hairs, black but in some lights with pale brown reflections, springing from slightly elevated polished bases; hypopygium with a central needle-like dorsal keel, the point translucent, the broadened rounded base hairy; its lateral lobes strongly haired, their slender inward-hinged terminal joints somewhat clubshaped and ending with a pointed lateral projection on each. Length, dry examples, 3 mm.; in balsam, nearly 4 mm.

♀. Much paler and more yellowish-brown than the male; the abdomen distended, not so conspicuously hairy; the wings slightly shorter and broader; antennae of six visible joints, the disc-like basal joint smaller than in the ♂ and yellowish-brown; the second joint slightly larger than the remaining four, which are of nearly equal length; all but the basal and terminal joints bear a few long sub-erect hairs; hairs of terminal joint very fine and short; palpi as in the ♂; eyes black; thorax more densely colored than the abdomen; its hairs pale yellowish-brown; leg-vestiture dark. The large bodied females shrink so in drying that measurements of them are deceptive; in balsam they slightly exceed the ♂ in length.

Described and illustrated from many examples of both sexes, of which I designate as types, ♂ and ♀, a pair mounted dry and deposited in the U. S. National Museum (Cat. No. 20317); paratypes are with the Academy of Natural Sciences, Philadelphia, and in my own collection.

Type locality, Mount Eddy, near Sisson, Siskiyou County, California; occurrence of larvae, pupae and flies, apparently throughout the warm months; hibernation probably as larvae of various ages.

This insect, which I provisionally describe under *Metriocnemus*, eventually may find its place in a related genus; *knabi* already has been separated by a European student of the group, who finds that it has well-developed pulvilli, a character which I have been unable to detect in *edwardsi*; slides of the ♂ genitalia of the two species indicate that in *knabi* the keel is shorter, slighter and more transparent, and the lateral lobes proportionately shorter and broader. The presence of larvae of *edwardsi* in almost every suitable leaf of *Darlingtonia* containing insect remains indicates that its association with this plant, like that of *knabi* with *purpurea*, is habitual, and possibly exclusive.

In the leaves of *Darlingtonia*, along with the larvae of *Metriocnemus* and as far as was observed living in amicable relationship with them, was found another dipterous larva sharing the same food-supply of captured insects. The larvae of the two species, often more or less entwined in their confined quarters, are not conspicuously different in size or form though separable to the naked eye by their different methods of progression; under low magnification it becomes immediately apparent that their relationship is remote. Eggs and empty puparia were also found in abundance in the leaves, and from the larvae numerous flies were bred to maturity. These prove to belong to the family *Chloropidae*, and, I am informed, belong to one of the three or more species standing in American collections under the name of *Botanobia trigramma* Loew; *trigramma* was described from the District of Columbia, its size is given as only about half the average and much less than the apparent minimum size of the present species, for which I propose the name of

Botanobia darlingtoniae n. sp. (Diptera: Chloropidae.) (Plate XXI.)

The eggs of this fly are deposited singly on the inner wall of the leaf, above the mass of insect remains and often well up toward the orifice of the pitcher; they are not strongly adherent and are frequently wedged under the fine elastic hairs which clothe the leaf-wall. From one to twenty eggs may be

found in a leaf, but even when most numerous they do not appear to have been laid in groups or clusters, and the maximum number is attributable to the visits of more than one female to the same leaf.

Egg.—Cigar-shaped, roundedly-pointed at one end, the other with a short cylindrical or collar-like cap of less diameter than the body of the egg; obscurely and shallowly wrinkled longitudinally; white, opaque, pearly, faintly polished, under 100 X finely punctate; length .9 mm., and greatest diameter .2 mm.

Larva.—Slender, cylindrical, tapering and strongly retractile anteriorly; white, translucent, smooth, but segmentally with narrow ventral fusiform areas marked by short acute granules, coarser beneath and fading out laterally; black cephalo-pharyngeal skeleton with two great hooks visible through the translucent anterior segments; anterior spiracle inconspicuous, few-lobed, concolorous, not protruded; the two posterior dorsal stigmata in form of even-armed crosses surmounting prominent dome-shaped processes, the inner arm of each cross partially obliterated by the circular extremities of the tracheal tubes; anal lobes low, smoothly rounded; extreme length about 5 mm. The larvae are active, moving freely about among the insect remains and climbing up the vertical wall of the pitcher in search of food or when ready to pupate.

Puparium.—Shorter and stouter than the larva and hardening to a dull bronzy-brown color; flattened ventrally where in contact with the leaf; segmentation not distinct; first visible segment flattened, transversely wrinkled, darker in color; anterior spiracles small, hand-like, slightly projecting, black; second segment low-arched, the succeeding segments more highly arched until posteriorly they become almost cylindrical; the anterior segments on their lateral edges above have a well marked longitudinal angular depression, outside of which the margin is produced and rounded; the terminal dome-shaped processes bearing the shrunk larval stigmata are prominent but less regularly shaped than in the larva, concentrically wrinkled, and the dorsal area immediately preceding them is also roughened and transversely wrinkled; length, 3.5 mm.; pupation usually occurs among the dry insect remains or on the inner wall of the leaf often well up toward the orifice or even in the hood; pupal stage (in August) eight to ten days.

♂ ♀. Black, head and thorax not shining, surface roughened and thinly white-pollinose; mesonotum and scutellum studded with short spine-like black hairs; mesonotum three-striped, with an additional abbreviated dark stripe above each wing base; abdomen dark brown above (almost black when dry), broad, flattened, slightly glossed, microscopically punctate, finely haired; legs yellow and black.

Eyes widely separated, dark bronzy brown, finely pubescent; ocellar tubercle slightly raised, usually paler by denser pollinosity, the anterior ocellus inclined on its front edge; no frontal triangle, but a prominent slightly sunken narrowly oval dark marking, laterally pale-bordered, extending forward from anterior ocellus; orbits pale gray, those of the front sometimes tinged with brownish-yellow; the front produced, broadly snout-like, over the base of the antennae, this produced and rounded area being pale dull brownish-yellow, with several rows of recumbent and convergent hairs; a pair of post-ocellar bristles, erect, converging, their points crossed; these, with a pair of erect and divergent outer verticals, are the strongest of the head bristles, which are black, usually from black bases.

Antennae large, directed laterally, appressed to head; the first joint hidden, the second broadly bell-shaped, yellow often partially obscured with dark and with a marginal row of spur-like hairs from black bases; the third joint much enlarged, longer than broad, rounded apically, basally on inner side dull salmon-yellow, sometimes ferruginous, the remainder dark purplish gray, almost black, and both joints thinly and finely white pollinose; arista black and tapering, shortly and sparsely haired. The cheeks produced in advance of the face, in color pale dull brown sometimes varying to and always merging into the gray of the posterior orbits; cheeks conspicuously marked with black dots which form the bases of recumbent forward-pointing hairs; a pair of well-differentiated brown vibrissal hairs; the black dots continued in a regular row around the posterior orbits. Face black; clypeus and well defined median carina pale. Mesonotum with a narrow black median stripe (a dull black area destitute of pollen) extending to scutellum, two similar lateral stripes abbreviated slightly in advance of scutellum, and two short dark markings above the wing bases. On each side two humeral bristles, one to two anterior and two posterior notopleurals, two post alar and one pre-scutellar; the uppermost anterior notopleural weak and apparently sometimes missing.

Scutellum broad, rounded, almost semi-circular in outline, discally flattened, in color and texture like the mesonotum, but laterally broadly darker; marginal scutellars black, four pairs distinguishable; median pair best developed, their points approaching or crossed.

Halteres long, club-shaped, white, unmarked, their stems sometimes darkened to almost black.

Wings transparent, unmarked, iridescent, their surface roughened with minute evenly distributed rasp-like hairs; veins dark brown; anterior edge closely set with short bristly hairs directed obliquely forward, gradually merging into the short fine even-length fringe; the costal thickening obvious to V 1 plus 2 (4th longitudinal); axillary incision very deeply out, its extremity rounded, separating from the rest

of the wing a long finger-shaped axillary lobe which is edged interiorly with long black hairs; second and third costal divisions equal, each twice as long as first; hind cross-vein twice its length from small cross-vein; III 4 plus 5 and V 1 plus 2 (third and fourth longitudinal) parallel.

Femora and tibiae set with stiff hairs; femora black usually shortly tipped with ferruginous yellow; tibiae yellow, broadly black-banded beyond the middle; tarsi yellow, terminal joints darkened to almost black; middle and hind legs with short tibial spurs.

Abdomen as stated, that of the ♂ rounded posteriorly, of the ♀ with an extruded hypopygium which is slender, tapering, finely haired, furcate and appressed, a long bristle terminating each fork; lateral and ventral posterior margins of segments gray-edged.

Average length, dry specimens, ♂, 2.1 mm.; ♀, 2.4 mm.; minimum and maximum of twelve examples 1.9 mm. and 2.8 mm.

Type locality Mount Eddy, near Sisson, Siskiyou County, California; types ♂ and ♀, are in the U. S. National Museum (Cat. No. 20318), paratypes with the Academy of Natural Sciences, Philadelphia, and in my own collection.

Eggs, larvae and puparia were abundant in the plants July 26; emergences of the flies took place from July 29th to August 19th; plants examined September 26th contained many empty puparia, no living early stages, and a single ♀ fly, indicating probable hibernation in the final stage.

In the preparation of this paper I am indebted to several entomologists for examination of specimens and courteous reply to my inquiries, and especially to Mr. Frederick Knab and Mr. E. T. Cresson, Jr., without whose generous assistance and criticism its completion would have been most difficult.

EXPLANATION OF PLATES.

PLATE XX.

Metriocnemus edwardsi. Egg mass, male, female head, pupa, male genitalia, labium of larva, male palpus, larva.

PLATE XXI.

Botanobia darlingtoniae. Female, egg, head-profile, puparium, larva, cephalopharyngeal skeleton, dorsal view of caudal end of larva.

Change of Address.

Mr. NATHAN BANKS, of East Falls Church, Va., Assistant Entomologist, Division of Entomology, U. S. Dept. of Agriculture, since 1896, announces that, after November 1, his address will be Museum of Comparative Zoology, Cambridge, Mass.